WIRING STRUCTURE FOR FOLDING PORTABLE DEVICE

This application claims priority to prior application JP 2002-354554, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION:

This invention relates to a folding portable (or hand-held) device that has upper and lower units coupled to each other with a hinge mechanism having a folding/unfolding axis and a rotating axis perpendicular to the folding/unfolding axis. Particularly, this invention relates to a wiring structure used in the folding portable device together with the hinge mechanism.

Recently, most of mobile phones have various additive functions, such as a browser, a mailer, a personal information scheduler and the like. The mobile phone is increasingly becoming sophisticated as a portable information terminal. Accordingly, a larger display for the mobile phone is required to display letters, characters (or ideographs), numerals, a static image(s) and/or a moving image(s). Meanwhile, there is a demand for weight saving and miniaturizing of the mobile phone.

Employing a folding structure can meet the above-mentioned incompatible demands in a measure. An existing folding mobile phone comprises upper and lower units and a hinge mechanism which couples the units to each other. In the existing folding mobile phone, a display is provide in the upper unit while a key set is provided in the lower unit. The display and the key set come close to each other, as the upper and the lower units are unfolded by means of the hinge mechanism. When the upper and the lower units are completely unfolded, the display and the key set are hidden by them.

A certain type (hereinafter referred to as a rotatable type) of the existing folding mobile phone can expose the display even when the upper and the lower units are completely folded. This is accomplished by, for example, using a ball joint as the hinge mechanism. The ball joint enables the upper unit to be rotated with respect to the lower unit. The rotatable type folding mobile phone allows a user to use the browser, the mailer or the like when the upper and the lower units are folded. Such a rotatable folding mobile phone is disclosed in Japanese Unexamined Patent Publication (JP-A) No. Tokkaihei 11-215218.

Now, a serious matter is a wiring structure between the upper unit and the lower unit of the rotatable folding mobile phone. That is, the wiring structure must have durability and a smaller size. However, the above mentioned document does not teach or suggested about the wiring structure.

Additionally, a personal information terminal employing a structure like the rotatable folding mobile phone needs a manner to allow of compact housing of signal lines, which amount to dozens or about a hundred.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a wiring structure capable of having durability and of being compactly incorporated in a hinge mechanism having a folding/unfolding axis and a rotative axis.

Another object of this invention is to provide a wiring structure capable of having a large number of signal lines and of being compactly incorporated in a hinge mechanism having a folding/unfolding axis and a rotating axis.

Other objects of this invention will become clear as the description proceeds.

According to a first aspect of this invention, a wiring device is uses in a folding portable device including an upper unit, a lower unit and a hinge unit mechanically connecting the upper unit to the lower unit. The hinge unit has a rotating axis for rotating the upper unit in relation to the lower unit and a folding/unfolding axis perpendicular to the rotating axis for folding/unfolding the upper unit in relation to the lower unit. The said wiring device comprises a rotative direction wound portion having a first central axis corresponding to the rotating axis to be wound with a first part of a flexible printed cable which electrically connects the upper unit to the lower unit. A folding/unfolding direction wound portion has a second central axis corresponding to the folding/unfolding axis to be wound with a second part of the flexible printed cable.

According to a second aspect of this invention, a wiring device is used in a folding portable device including an upper unit, a lower unit and a hinge unit mechanically connecting the upper unit to the lower unit. The hinge unit has a rotating axis for rotating the upper unit in relation to the lower unit and a folding/unfolding axis perpendicular to the rotating axis for folding/unfolding the upper unit in relation to the lower unit. The wiring device comprises a rotative direction wound portion having a first central axis corresponding to the rotating axis to be wound with a first part of a flexible printed cable which electrically connects the upper unit to the lower unit. A folding/unfolding direction wound portion has a second central axis corresponding to the folding/unfolding axis to be wound with a second part of the flexible printed cable. A cable fixing portion fixes a third part between the first part and the second part of the flexible printed cable.

According to a third aspect of this invention, a wiring method is for wiring a flexible printed cable between an upper unit and a lower unit of a folding portable device. The upper unit and the lower unit are mechanically connected to each other by a hinge unit having a rotating axis for rotating the upper unit in relation to the lower unit and a folding/unfolding axis perpendicular to the rotating axis for folding/unfolding the upper unit in relation to the lower unit. The method comprises the steps of fixing a predetermined part of the flexible printed cable to the hinge unit, winding a first winding part of the flexible printed cable around a rotative direction wound portion having a first central axis corresponding to the rotating axis, and winding a second winding part of the flexible printed cable around a folding/unfolding direction wound portion having a second central axis corresponding to the folding/unfolding axis.

According to a fourth aspect of this invention, a folding portable device includes an upper unit, a lower unit and a hinge unit for mechanically connecting the upper unit to the lower unit. The hinge unit has a rotating axis for rotating the upper unit in relation to the lower unit and a folding/unfolding axis perpendicular to the rotating axis for folding/unfolding the upper unit in relation to the lower unit. The folding portable device comprises a flexible printed cable for electrically connecting the upper unit to the lower unit. A rotative direction wound portion has a first central axis corresponding to the rotating axis to be wound with a first part of the flexible printed cable around the rotating axis. A folding/unfolding direction wound portion has a second central axis to be wound with a second part of the flexible printed cable around the folding/unfolding axis.